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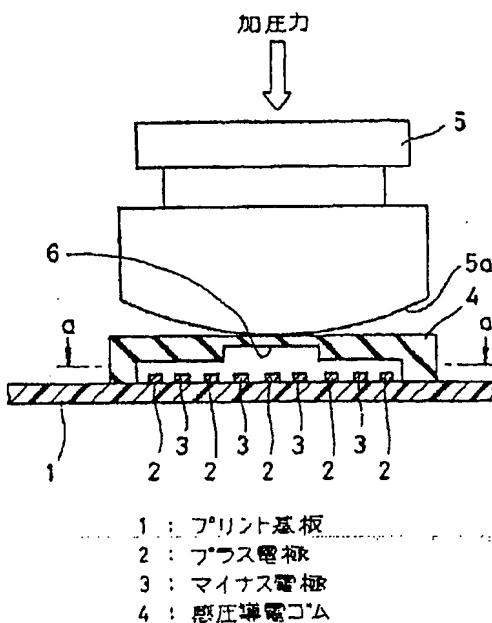
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(54)【発明の名称】 感圧スイッチ

(57)【要約】

【目的】 小さな加圧力を瞬間に加えるだけで感圧導電ゴムの抵抗値を急激に低下させる。

【構成】 感圧導電ゴム4を断面逆凹状形状に形成してつぶれやすくする。感圧導電ゴム4のつぶれ変形に伴って、電極2、3との間の接触面積が増大しつつ感圧導電ゴム4自体の通電抵抗が急激に低下する性質を利用して、電極2、3同士の間のスイッチング作用を行わせる。



1 : プリント基板

2 : プラス電極

3 : マイナス電極

4 : 感圧導電ゴム

### 【特許請求の範囲】

【請求項1】陽極および陰極のうち少なくとも一方の電極が設けられた基板上に感圧導電ゴムを配置してなり、この感圧導電ゴムを加圧することにより、該感圧導電ゴム自身の圧縮変形に伴う抵抗変化によって感圧導電ゴムを可動接点として一方の電極と他方の電極との間のスイッチング作用を行わせるようにした感圧スイッチであって、

前記感圧導電ゴムの無加圧状態において、この感圧導電ゴムと前記一方の電極とが非接触となるように感圧導電ゴムを断面逆凹状形状に形成したことを特徴とする感圧スイッチ。

### 【発明の詳細な説明】

#### 【0001】

【産業上の利用分野】本発明は、感圧導電ゴムの加圧に伴う抵抗変化を利用してスイッチング作用を行わせるようにした感圧スイッチに関する。

#### 【0002】

【従来の技術】感圧導電ゴムを用いた感圧スイッチとして、例えば特開昭52-5477号公報に示されているように、感圧導電ゴムにて形成された一方のシート電極の表面に多数の山形状の突起部を形成する一方、この突起部が形成されたシート電極の表面に導電布等からなる他方のシート電極を貼り合わせ、双方の電極を加圧した場合に、前記突起部の圧縮変形により両電極間の接触面積が増大するに伴ってその通電抵抗が急激に小さくなる性質を利用して、両電極間のスイッチング作用を行わせるようにしたものが知られている。

#### 【0003】

【発明が解決しようとする課題】上記のような従来の感圧スイッチにおいては、ある程度まで加圧力を増大させると感圧導電ゴムの抵抗値が小さくなる傾向が認められるものの、微小な加圧力のものでは抵抗値が無限大のままで何ら変化せず、スイッチング作用を行わせるのに必要な初期加圧力が比較的大きくなつて好ましくない。

【0004】また、従来の構造では、特定の加圧力まで加圧した場合にその抵抗値が低下したとしても、抵抗値の低下落差すなわち加圧に伴う抵抗値の低下の度合が小さくて抵抗値の低下特性が緩慢となり、その低下特性のばらつき等を考慮すると感圧スイッチとしての機能を十分に発揮させることができない。

【0005】このようなことから、上記の抵抗値の低下特性を改善するために、前記突起部の高さを一つ置きに異ならしめた構造のものが特願平3-234523号として本出願人により提案されているが、このタイプのものでは、図4に破線Aで示すように、先のものよりも急激な抵抗値の低下特性が認められるものの、抵抗値が低下し始めてから特定の値で飽和するまでの落差の面で必ずしも十分でないばかりでなく、その落差を得るための荷重変化が比較的大きいために実用性の上でなおも課題

を残している。

【0006】本発明は以上のような課題に着目してなされたもので、初期加圧力が小さく、しかも小さい加圧力変化のなかでより大きな抵抗値の落差が得られるようにした構造を提供しようとするものである。

#### 【0007】

【課題を解決するための手段】本発明は、陽極および陰極のうち少なくとも一方の電極が設けられた基板上に感圧導電ゴムを配置してなり、この感圧導電ゴムを加圧することにより、該感圧導電ゴム自身の圧縮変形に伴う抵抗変化によって感圧導電ゴムを可動接点として一方の電極と他方の電極との間のスイッチング作用を行わせるようにした感圧スイッチであって、前記感圧導電ゴムの無加圧状態において、この感圧導電ゴムと前記一方の電極とが非接触となるように感圧導電ゴムを断面逆凹状形状に形成したことを特徴としている。

#### 【0008】

【作用】この構造によると、感圧導電ゴムを断面逆凹形状としたことによって、感圧導電ゴム自体がきわめて捲みやすくなり、感圧導電ゴムを加圧するにしたがって電極との接触面積を大きくして抵抗値を下げるとする感圧スイッチの要求特性とも合致する。したがって、電極に対する感圧導電ゴムの接触面積をより大きく確保でき、微小な加圧力でも抵抗値が急激に低下するとともに、加圧力をそれ以上増大させる必要もなくなる。

#### 【0009】

【実施例】図1、2は本発明の一実施例を示す図で、キーボードスイッチに適用した場合の例を示している。

【0010】図1、2に示すように、プリント基板1上には、複数のプラス電極2とマイナス電極3とが互い違いとなるようにバター印刷により全体としてくし形状に形成されている。前記プリント基板1の上には双方の電極2、3を覆うように感圧導電ゴム4がかぶせられ、その感圧導電ゴム4の上には所定曲率の円弧状の押圧面5aを有するキートップ5が置かれている。

【0011】そして、前記感圧導電ゴム4は、無加圧状態において電極2、3と接触することができないように全体として断面逆凹状形状に形成されているとともに、その内下面の中央部には凹陷部6が形成されており、これにより感圧導電ゴム4の中央部が最も薄肉に形成されている。

【0012】したがって、本実施例構造によれば、キートップ5を介して感圧導電ゴム4を加圧すると、図3に示すように感圧導電ゴム4が瞬時につぶれて、少なくとも複数のプラス電極2、2…のいずれかとマイナス電極3、3…のいずれかに接触する。

【0013】そして、上記のように感圧導電ゴム4がつぶれて変形すると、プラス電極2とマイナス電極3とが感圧導電ゴム4を可動接点として単に導通するだけではなく、感圧導電ゴム4の変形に伴つてその接触面積が増

大することで感圧導電ゴム4自体の通電抵抗が瞬時のうちに急激に低下する。これにより、プラス電極2とマイナス電極3との間に必要な電流が流れてスイッチング作用が行われる。

【0014】図4の実線Bは、上記実施例における感圧導電ゴム4の抵抗値の低下特性を示したもので、無加圧状態では感圧導電ゴム4の抵抗値が無限大であるのに対して、加圧するとその加圧力が90~40g f程度の範囲内で急激に低下し、それ以上の加圧力では抵抗値の低下度合が緩慢になるものの400g f程度までは緩やかに低下し、400g f以上の加圧力では零に近い抵抗値で安定化する。

【0015】つまり、本実施例によれば、微小な加圧力を加えるだけで感圧導電ゴム4の抵抗値が急激に低下することから初期加圧力が著しく小さくて済み、しかも抵抗値が一旦低下すればそれ以上加圧力を増やすことなしにスイッチング作用に必要十分な抵抗値の落差が得られることになる。

【0016】また、感圧導電ゴム4が断面逆凹状形状であって無加圧状態では空洞状となっていることから、感圧導電ゴム4のつぶれ変形によってスイッチング作用時の節度感も得られる。

【0017】なお、上記実施例では、プリント基板1上に陽陰双方の電極2、3を配置した場合の例を示しているが、プリント基板1上には陽陰いずれか一方の電極のみを配置し、他方の電極を感圧導電ゴム4の上側もしくは感圧導電ゴム4内に配置してもよい。

【0018】

【発明の効果】以上のように本発明によれば、感圧導電ゴムを可動接点として用いてこの感圧導電ゴムの加圧に伴う抵抗変化によりスイッチング作用を行うにあたり、感圧導電ゴムを断面逆凹状形状に形成したことから、感圧導電ゴムがきわめてつぶれ変形しやすいものとなって、そのつぶれ変形時の接触面積を大きく確保できるようになり、微小な加圧力を瞬間に加えるだけで大きな抵抗値の落差が得られるとともに、一旦抵抗値が低下し始めるとそれ以上加圧力を増大させる必要もなく、感圧スイッチとしての感度もしくは応答性が大幅に向上する。

【0019】また、感圧導電ゴムの加圧時にその感圧導電ゴム自体のつぶれ変形に伴う節度感も得られることから、感圧スイッチの操作性の面でもより良好なものとなる。

#### 【図面の簡単な説明】

【図1】本発明の一実施例を示す無加圧時の断面図。

【図2】図1のa-a線に沿う断面図。

【図3】図1に示す感圧スイッチの加圧時の断面図。

【図4】上記感圧スイッチの加圧力(荷重)と抵抗値との関係を示す特性図。

#### 【符号の説明】

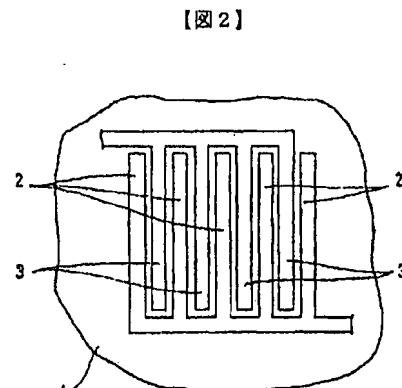
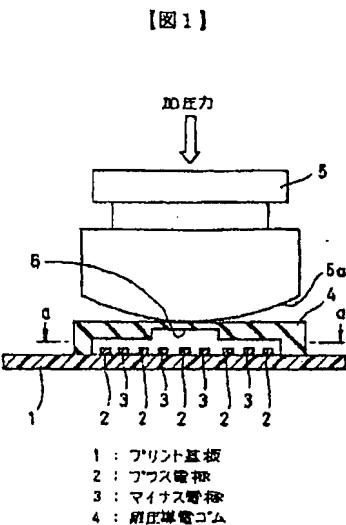
1…プリント基板

2…プラス電極

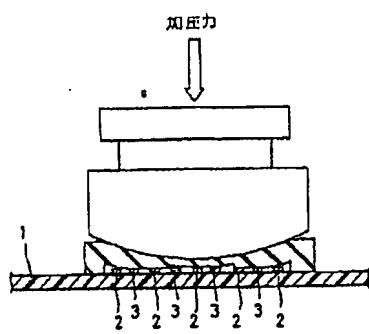
3…マイナス電極

4…感圧導電ゴム

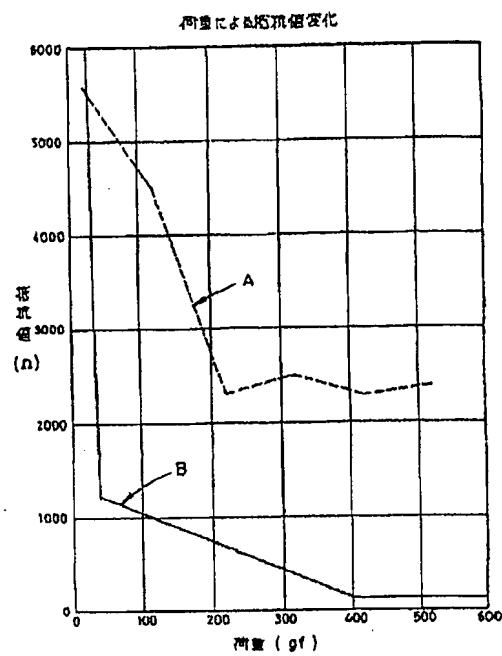
5…キートップ



【図3】



【図4】



# JAPANESE LAID-OPEN PATENT APPLICATION

**H5-304007 (1993)**

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(12) Laid-Open Patent Application (A)	(43) Publication Date	November 16, 1993		
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No examination request			Number of claims 1 (totally 4 pages)	

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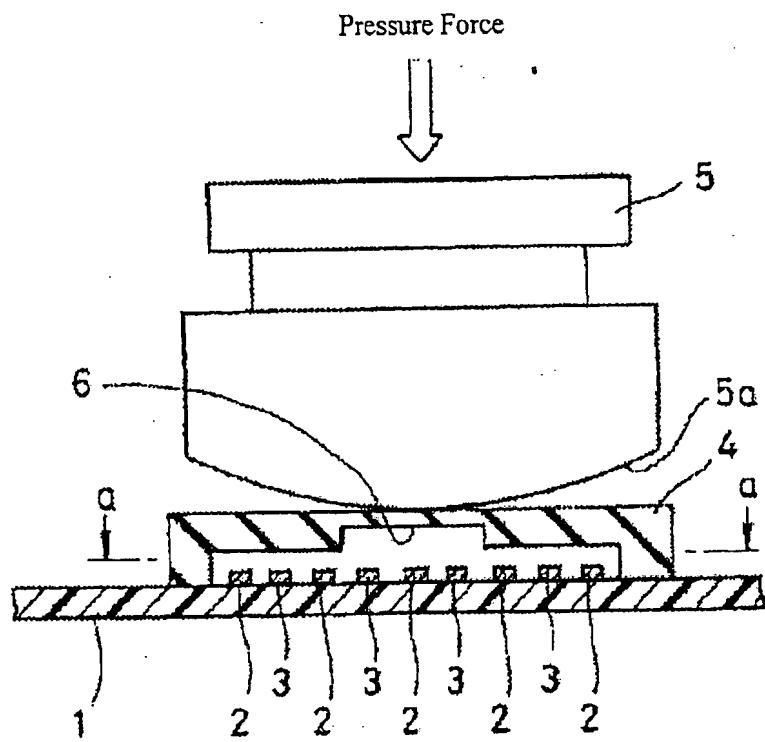
## Specification

(54) [Title of the Invention] Pressure Sensitive Switch

(57) [Abstract]

[Purpose] To suddenly lower the resistance value of pressure-sensitive conductive rubber by instantaneously applying a small pressure force.

[Constitution] Pressure-sensing conductive rubber 4 is formed in the cross-sectional shape of an inverted recess to make it easy to collapse. A switching operation between electrodes 2 and 3 is conducted by utilizing such a property that the electrical resistance of the pressure-sensitive conductive rubber 4 itself suddenly lowers while the contact area between the electrodes 2 and 3 increases with the collapse deformation of the pressure-sensitive conductive rubber 4.



1 : printing board

2 : positive electrode

3 : negative electrode

4 : pressure-sensitive conductive rubber

### [Claims]

**[Claim 1]** A pressure sensitive switch made by arranging pressure-sensitive conductive rubber on a board provided with at least one of a positive electrode and a negative electrode and accomplishes switching between one electrode and the other electrode with the pressure-sensitive conductive rubber as the center due to a resistance change accompanied by the compressive deformation of the pressure-sensitive conductive rubber itself, by pressurizing the pressure-sensitive conductive rubber and is characterized by forming the pressure-sensitive conductive rubber in the

cross-sectional shape of an inverted recess so that the pressure-sensitive conductive rubber and one electrode do not make contact in the non-pressure state of the pressure-sensitive conductive rubber.

### **[Detailed Description of the Invention]**

#### **[0001]**

**[Field of industrial application]** The present invention relates to a pressure sensitive switch that accomplishes switching by use of a resistance change accompanied by the applied pressure of a pressure-sensitive conductive rubber.

#### **[0002]**

**[Prior Art]** As a pressure sensitive switch using a pressure-sensitive conductive rubber, for example, as shown in Japanese Laid-Open Patent Application 52-5477, it has been known that many hill-like projections are formed on the surface of one sheet electrode formed by a pressure-sensitive conductive rubber while the other sheet electrode made of a conductive cloth or the like is pasted to the surface of a sheet electrode formed with these projections. When both electrodes are pressurized, switching is accomplished between the electrodes by use of the property that their electrical resistance is suddenly lowered by increasing the contact area between the two electrodes due to the compressive deformation of the projections.

#### **[0003]**

**[Problem overcome by the invention]** In the conventional pressure sensitive switch described above, if the applied pressure force is increased to some extent, there is a tendency for the resistance value of the pressure-sensitive conductive rubber to reduce, but the resistance value is not changed, remaining infinite under a very small applied pressure force and the initial applied pressure force necessary for switching relatively increases, which is undesirable.

**[0004]** In the conventional structure, when it is pressurized to a specific applied pressure force, even if its resistance value lowers, dropping of the resistance value, i.e., the degree of lowering of the resistance value accompanied by the applied pressure, is reduced, the lowering characteristic of resistance value is slowed, if the dispersion of the lowering characteristic is considered, its function as a pressure sensitive switch could not be fully displayed.

**[0005]** From such a perspective, a pressure sensitive switch of a structure in which the height of the projections is allowed to be alternately different to improve the lowering of above resistance

value has been proposed by the present applicant as Japanese Patent Application H3-234523. In this type of pressure sensitive switch, as shown by the broken line A in Fig. 4, a more sudden lowering characteristic is found, but it not only is insufficient in a drop from the beginning of lowering of the resistance value to its saturation at a specific value, but also the load change required to obtain the drop is bigger, and there is still a problem of practicability.

[0006] The present invention focuses on the problems described above and provides a structure that has a small initial applied pressure force and provides a larger drop in resistance value with a small change of applied pressure force.

[0007]

[Problem resolution means] The present invention is a pressure sensitive switch which arranges pressure-sensitive conductive rubber on a board provided with at least one of a positive electrode and a negative electrode and accomplishes switching between one electrode and the other electrode with the pressure-sensitive conductive rubber as the center due to the resistance change accompanied by the compressive deformation of the pressure-sensitive conductive rubber, by pressurizing the pressure-sensitive conductive rubber, and characteristically forms the pressure-sensitive conductive rubber in the cross-sectional shape of an inverted recess so that the pressure-sensitive conductive rubber and one electrode come into non-contact in the non-pressure state of the pressure-sensitive conductive rubber.

[0008]

[Function] According to this structure, the pressure-sensitive conductive rubber is made extremely easy to flex by making the pressure-sensitive conductive rubber in the cross-sectional shape of an inverted recess, and also conforms to a required characteristic of the pressure sensitive switch that the contact area with the electrodes be increased with pressurizing the pressure-sensitive conductive rubber to lower the resistance value. Accordingly, a larger contact area of the pressure-sensitive conductive rubber for the electrodes may be ensured, the resistance value is also suddenly lowered at a very small applied pressure force, eliminating the need to further increase the applied pressure force.

[0009]

[Example] Figs. 1 and 2 are diagrams showing an example of the present invention, and show an example applied to a keyboard switch.

[0010] As shown in Figs. 1 and 2, multiple positive electrodes 2 and multiple negative electrodes 3 are formed on a print board 1 in such a shape that they are made overall different from each other by pattern printing. A pressure-sensitive conductive rubber 4 is placed on the print board 1 so as to cover both the electrodes 2 and 3, and a key top 5 having an arc-like pressing surface 5a of a prescribed curvature is placed on the pressure-sensitive conductive rubber 4.

[0011] Then, the pressure-sensitive conductive rubber 4 is entirely formed in the cross-sectional shape of an inverted recess so that it does not make contact with the electrodes 2 and 3 in a non-pressure state, a depression 6 is formed at the center of the downside thereof, and the center of pressure-sensitive conductive rubber is formed into a thinner thickness.

[0012] Therefore, according to the structure of this example, if the pressure-sensing conductive rubber 4 is pressurized via the key top 5, as shown in Fig. 3, the pressure-sensitive conductive rubber 4 collapses instantaneously, and it comes into contact with at least one of multiple positive electrodes 2, 2 ... and one of multiple negative electrodes 3, 3 ....

[0013] If the pressure-sensitive conductive rubber 4 collapses and becomes deformed as described above, not only do the positive electrode 2 and the negative electrode 3 simply conduct with the pressure-sensitive conductive rubber 4 as a movable contact, but also the electrical resistance of the pressure-sensing conductive rubber 4 is instantly lowered by increasing the contact area with the deformation of the pressure-sensitive conductive rubber 4, a necessary current flowing between the positive electrode 2 and the negative electrode 3 to accomplish switching.

[0014] The above example A solid line B of Fig. 4 shows the lowering characteristic of resistance value of the pressure-sensitive conductive rubber 4. The resistance value of the pressure-sensitive conductive rubber 4 is infinite in the non-pressure state, and in contrast, if pressure is applied, the resistance value suddenly lowers wherein, in a range in which the applied pressure force is about 30 ~ 40 gf; the lowering degree of the resistance value slows down at a greater applied pressure force, and gently lowers until it reaches an applied pressure force of about 400 gf, and the resistance value stabilizes at a resistance value close to zero and at an applied pressure force greater than 400 gf.

[0015] According to this example, the resistance value of pressure-sensing conductive rubber 4 is suddenly lowered by applying only a very small applied pressure force, markedly reducing the initial applied pressure force. Moreover, once the resistance value is lowered, a sufficient drop of resistance value necessary for switching is obtained without further increasing the applied pressure force.

[0016] Since the pressure-sensitive conductive rubber 4 has the cross-sectional shape of an inverted recess and becomes cavity-like in the non-pressure state, a moderate feeling in the switching is obtained by the collapse deformation of the pressure-sensitive conductive rubber 4.

[0017] An example of arranging both the plus and negative electrodes 2, 3 on the print board 1 is shown in the above embodiment example, but only one of either a positive or negative electrode may be arranged on the print board 1 and the other electrode may be arranged on the upper side of or within the pressure-sensitive conductive rubber 4.

[0018]

**[Efficacy of the invention]** According to the present invention as described above, the pressure-sensing conductive rubber is formed in the cross-sectional shape of an inverted recess when accomplishing switching due to a resistance change accompanied by the applied pressure of the pressure-sensitive conductive rubber with the pressure-sensitive conductive rubber as a movable contact, therefore the pressure-sensitive conductive rubber is easily collapsed and deformed, ensuring a large contact area in the collapse deformation, and a large drop of resistance value is instantaneously obtained by applying only a very small applied pressure, and once the resistance value starts to lower, additional pressure force need not be applied, greatly improving the sensitivity or responsiveness as a pressure sensitive switch.

[0019] Since a moderate feeling accompanied by the collapse deformation of the pressure-sensitive conductive rubber itself is also obtained when the pressure-sensitive conductive rubber is pressurized, the pressure sensitive switch also operates satisfactorily.

**[Brief description of the drawings]**

[Fig. 1] Sectional view at the time of no applied pressure showing an example of the present invention.

[Fig. 2] Sectional view along the a-a line of Fig. 1.

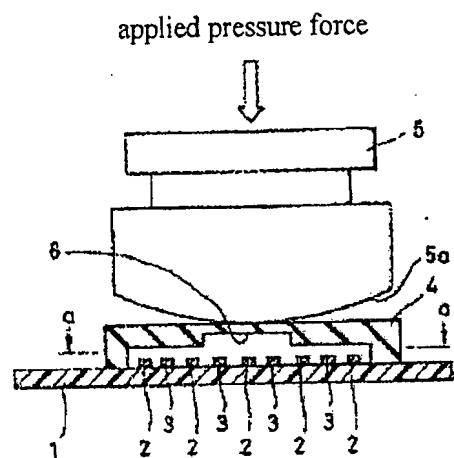
[Fig. 3] Sectional view of a pressure sensitive switch at the time of applied pressure showing an example of the present invention.

[Fig. 4] Characteristic diagram showing the relationship between the applied pressure force (load) and resistance value of the above pressure sensitive switch.

**[Description of the symbols]**

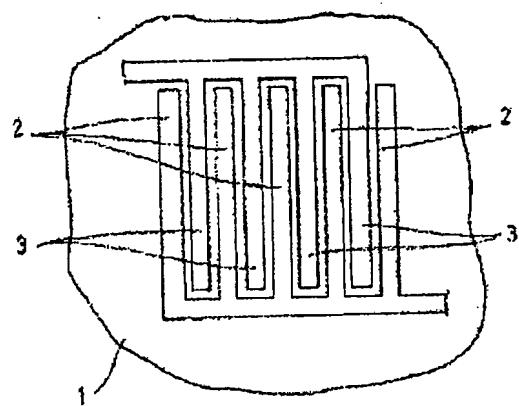
- 1: print board
- 2: positive electrode
- 3: negative electrode
- 4: pressure-sensitive conductive rubber
- 5: key top

[Fig. 1]

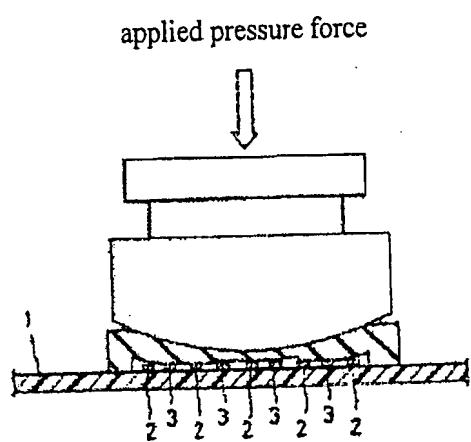


- 1: print board
- 2: positive electrode
- 3: negative electrode
- 4: pressure-sensitive conductive rubber

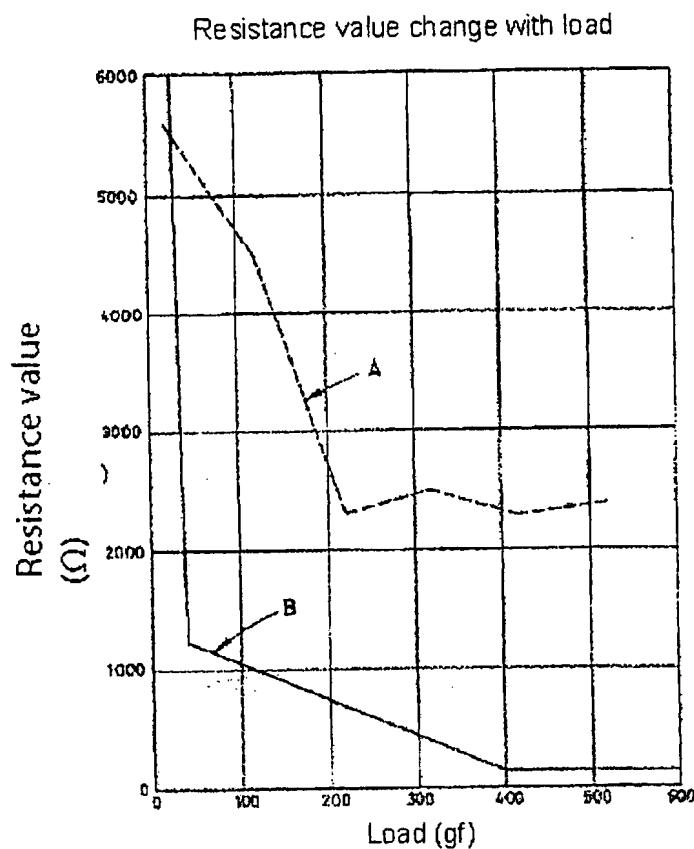
[Fig. 2]



[Fig. 3]



[Fig. 4]



CERTIFICATE OF TRANSLATION

I Roger P. Lewis, whose address is 42 Bird Street North, Martinsburg WV 25405, declare and state the following:

I am well acquainted with the English and Japanese languages and have in the past translated numerous English/Japanese documents of legal and/or technical content.

I hereby certify that the Japanese translation of the attached translation of documents identified as:

Laid Open Patent Application

H5-304007  
"Pressure Sensitive Switch"

is to the best of my knowledge and ability true and accurate.

I further declare that all statements contained herein of our own knowledge, are true, that all statements of information and belief are believed to be true.



ROGER P. LEWIS

October 24, 2006